SUSTAINABLE MATERIALS, PROCESSES AND SYSTEMS FOR ENERGY TRANSITION

DM630 UNINA/CAPTOP Srl - High-Performance GO-Based and Eumelanin related materials for Supercapacitors for Next-Generation Energy Storage & Generators

Funded By	Ministero dell'Università e della Ricerca - MUR [P.iva/CF:96446770586] UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II [P.iva/CF:00876220633] CapTop S.r.l. [P.iva/CF:08580581216]
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Context of the research activity	High-Performance GO-Based and Eumelanin related materials for Supercapacitors for Next-Generation Energy Storage and Thermoelectric Generators. Energy density of Supercapacitors remains a significant challenge, limiting their widespread application. Graphene oxide (GO), a two-dimensional nanomaterial derived from graphite, presents a promising solution due to its remarkable electrical conductivity, high surface area, and excellent mechanical strength. Eumelanin can be seen as a natural relative of GO and also will be investigated as sustainable unconventional material for energy harvesting and sensing applications also in integration of organic- and chalcogen-based radical dopants. This PhD research project focuses on exploring GO- as well as eumelanin based supercapacitors to address current limitations and develop novel electrode as well as transporting layer designs for improved performance and outlining steps for commercialization. Progetto finanziato dal PNRR a valere sul DM 630/2024 - CUP: E14D24002340004
	This research aims to achieve the following objectives: - GO/EUMEL-Based Supercapacitors Manufacturing: - Analyze limitations associated with GO/EUMel synthesis, scalability, and stability. - Explore methods for scalable production of GO/EUMEL suitable for future

Objectives	commercial applications, considering factors like cost-effectiveness and manufacturability. - Develop methodologies using [e.g., chemical reduction or hydrothermal processes] to mitigate in-plane and out-of-plane restacking, control aggregation behavior, and enhance solvent compatibility. - Characterize and Understand GO/EUMEL Properties: - Employ Brunauer-Emmett-Teller (BET) analysis to quantify surface area. - Utilize four-point probe measurements to assess electrical conductivity. - Characterize mechanical flexibility using techniques like nanoindentation. - Correlate the impact of GO/EUMEL structure and functional groups on supercapacitor performance. - Develop High-Performance Hybrid Materials: - Explore the synergistic effects of combining GO/EUMEL with various materials: - Metal oxides (MnO_2, RuO_2, NiO) for enhanced pseudocapacitance. - Transition metal dichalcogenides (MoS_2, WS_2) to improve energy storage capacity. - Phosphides, nitrides, and carbides to investigate their synergistic effects with GO/EUMEL for superior charge storage. - Conducting polymers (polyaniline, polypyrrole) for achieving higher capacitance. - Analyze the impact of these hybrid materials on specific capacitance and cycling stability through detailed characterization techniques (e.g., X-ray diffraction, Raman spectroscopy).

Skills and competencies for the development of the activity	The ideal candidate should preferably have a Master's Degree in Chemistry or Materials Science or Chemical Engineering